






## BMP #5b - Erosion Prevention on Temporary and Private Roads

### Targeted Pollutants

-  Sediment
-  Phosphorus
-  Trace metals
-  Bacteria
-  Petroleum hydrocarbons

### Physical Limits

Drainage area unlimited

Max slope 15%

Min bedrock depth 3 ft

Min water table N/A

SCS soil type ABCD

Freeze/Thaw good

Drainage/Flood control no

### DESCRIPTION

Any of several measures can be used to control erosion and sedimentation originating with haul roads, detours, access roads, and other unpaved or temporary roadbeds associated with a construction project. Possible measures include :

**Road Placement:** Place temporary roads as far as possible away from streams, surface waters or wetlands .

**Open-Top Box Culvert:** A wooden culvert installed across the road grade to convey surface runoff and roadside ditch flows to the downslope side. Open-top box culverts are useful for collecting surface runoff and ditch flows and channeling this water across the road without eroding the drainage system or road surface.

**Waterbar (or Cross Ditch):** A cut and berm built at a downward angle across the roadway, extending from the cutbank to the opposite fill shoulder. Waterbars reduce erosion by diverting storm water runoff from the road surface and directing it to a safe discharge area.

**Road Sloping:** Constructing the road with an outward slope of 1 to 2 percent from the cut slope to the fill slope. Sloped roads are designed to divert surface water off the entire road surface so that water does not concentrate in any specific location.

**Rolling Dip:** Constructing the road with shallow, outward-sloping dips or undulations to collect surface runoff and convey it away from the road surface.

**Level Spreader:** A drainage outlet constructed by cutting a shallow trench at zero grade across a slope to disperse concentrated runoff. Level spreaders convert concentrated flow into sheet flow for discharge at nonerosive velocities onto areas stabilized by vegetation. By reducing runoff velocity, they help reduce erosion, enable sediment to settle out, and enhance infiltration.

### APPLICATIONS

**Open-Top Box Culvert:** Used, as a substitute for pipe culverts, for cross drainage on lightly used, unpaved roads on steep grades (greater than 6 percent).

**Waterbar:** Used as a temporary or permanent drainage facility on light-use, low-maintenance, unpaved roads. Waterbars should be placed above grade changes to prevent water from flowing down steeper portions of roads or skid trails. Bars may also be placed above intersections of roads, skid trails, or landings to protect these disturbed areas.

**Road Sloping:** Used as a drainage measure on temporary or low-traffic haul roads where erosion of the roadbed and fill slope is unlikely due to low runoff volume or intensity.

**Rolling Dip:** Used as a runoff diversion measure to prevent erosion of the road surface. Rolling dips are effective on long inclines to keep storm water from flowing directly down the road, where it may cause gullying and other damage to the road surface and grade.

**Level Spreader:** Useful where concentrated runoff from bare ground or other unstabilized areas can be diverted onto stabilized areas under sheet flow conditions. Level spreaders are often placed at the outlets of diversion dikes or runoff interception trenches to control runoff, dissipate water velocity, and disperse the water over a broad surface area. Level spreaders are relatively inexpensive to install. They may be used on slopes of 3:1 or flatter.

## **LIMITATIONS**

**Open-Top Box Culvert:** Generally, box culverts are not required on grades of 6 percent or less and are ineffective under continuous or recurrent use where cleaning is sporadic.

**Waterbar:** Suitable only for light-use, low-maintenance, unpaved roads.

**Road Sloping:** Suitable only for low-traffic haul roads where runoff volume and intensity are low.

**Rolling Dip:** Not suitable on road grades steeper than 5 percent.

**Level Spreader:** Level spreaders are not recommended for use in most situations. They are not suitable on slopes steeper than 3:1 or where the soils are easily erodible. They should be constructed only on natural soils, not on fill material. Level spreaders cannot handle large quantities of sediment-laden storm water. If altered by erosion or other disturbance, they may "short circuit" and actually concentrate flows into small streams instead of spreading the flows into sheet flow.

## **DESIGN PARAMETERS**

**Open-Top Box Culvert:** Box culverts can be built from logs; lumber; discarded guardrail; or commercial, corrugated steel. They are installed at a skewed angle downgrade across the roadway, with the discharge end extending 6 to 12 in (150 to 300 mm) beyond the surface of the roadbed.

Spacing between culverts should be in accordance with recommended cross drainage spacing in Table 5b-1. Where recommended spacing is less than 33 ft (10 meters), the road should be paved with gravel or crushed rock.

**Waterbar:** Waterbars are generally constructed using a blade-equipped tractor or by hand. The size of the waterbar depends on the amount of precipitation in the area, the soil erodibility, and anticipated traffic.

- The waterbar should extend from the cutbank side of the road completely across to the fillslope side.
- Cut dimensions: Up to 16 in (400 mm) deep across road, 8 to 16 in (200 to 400 mm) deep at outlet, 3 to 4 ft (1.0 to 1.2 meters) wide.
- Berm dimensions and orientation: 1 to 2 ft (300 to 600 mm) high 5 in (150 mm) minimum height, skewed at angle of 30o to 40o across road.

- Spacing between bars: Use Table 5b-1, for recommended cross drain spacing on low to relatively moderately steep topography.
- Discharge: Runoff should not be directed onto fill material without proper energy dissipation and drainage away from the fill.

#### Road Sloping:

- The slope should be approximately 1 to 2 percent from the cut slope outward to the fill slope.
- Berms on the outside of the road should be limited or removed to allow water to flow off the road surface.
- Provide sediment collection or erosion-control measures at the toe of the fill slope to prevent excessive erosion and sediment transport.

#### Rolling Dip: (applies to roads greater than 150 ft long only)

- The dip should be approximately 1 ft (0.3 meter) below the surface plane of the road. The upgrade approach to the bottom of the dip should be approximately 66 ft (20 meters) long. The downgrade approach to the bottom of the dip should be approximately 23 ft (7 meters) long.
- Align the dip across the road at nearly a 90-degree angle and slope it outward approximately 5 percent.

**Table 5b-1. Recommended Cross Drain Spacing** (Source: ITD, 1994)

Road Grade (percent)	Spacing Between Open-Top Culverts, feet (meters)
2 to 5	300 to 500 (90 to 150)
6 to 10	200 to 300 (60 to 90)
11 to 15	100 to 200 (30 to 60)
16 to 20	<100 (<30)

## CONSTRUCTION GUIDELINES

**Open-Top Box Culvert:** Construct a box-like frame (three-sided, open-topped) of logs; lumber; discarded guardrail; or commercial, corrugated steel. Install it flush with the road surface, skewed at an angle downgrade across the roadway. Set the inflow end at the same grade as the side ditches on the road and extend it into the cut bank. The discharge end should extend 6 to 12 in (150 to 300 mm) beyond the surface of the roadbed and should be directed onto vegetated ground or riprap or into another erosion-control structure such as a sediment trap or catch basin.

**Waterbar:** Cut each waterbar into solid soil to a minimum depth of 6 in (150 mm) next to the cutbank and 8 in (200 mm) at the road shoulder, with an adverse grade on the downgrade or downroad side of the

waterbar. Build a continuous, firm berm of soil, at least 6 in (150 mm) above normal grade, parallel to the waterbar cut on its downhill side. Include a bank tie-in point, cut 6 to 12 in (150 to 300 mm) into the roadbed. For added stability, the bar may be compacted with a nonerosive fill material. The completed waterbar must extend across the full roadway width, aligned at an angle of 30° to 40° relative to the roadway. A dissipation or filter device (such as riprap or silt fence) may be needed below the waterbar to control erosion and trap sediment.

Road Sloping: Road sloping is built into the road during construction. Install erosion- and sediment-control measures downslope before completing the finish grade of the sloped road. Then construct the outward slope of 1 to 2 percent, as specified in the contract plans.

Rolling Dip: Rolling dips are built into the road, during construction, following the natural contours of the land. Install erosion and sediment measures at the low point of the dip (drainage outfall to fillslope) before final grading to direct storm water discharge from the dip. Construct the dip according to the specifications shown in the contract plans. If not specified, make the dip 1 ft (300 mm) deep, with a 23 ft (7-meter)-long approach on the downgrade side and a 66 ft (20-meter)-long approach on the upgrade side.

## **MAINTENANCE**

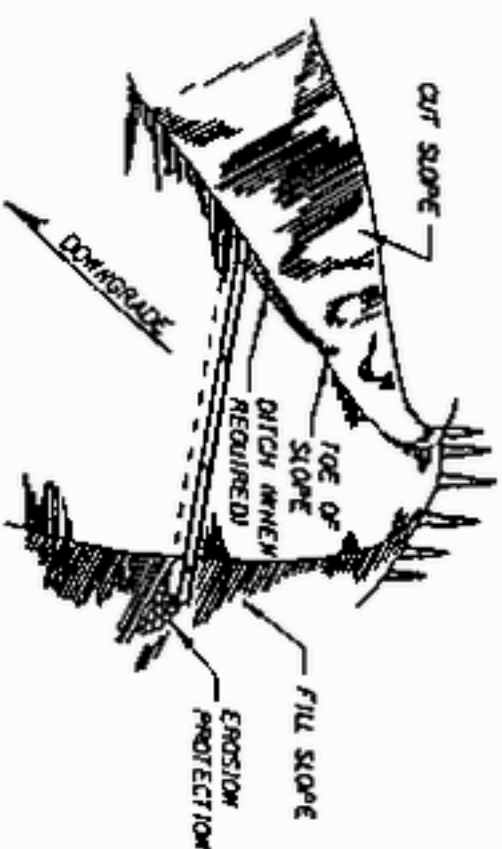
Inspect all devices regularly according to provisions of the contract or project site plan. Make repairs promptly to avoid progressive damage. Remove accumulated sediments as necessary to ensure proper functioning.

Open-Top Box Culvert: Clean and repair the culverts on a regular basis. Remove sediments and other debris which may block drainage flow or decrease structural efficiency.

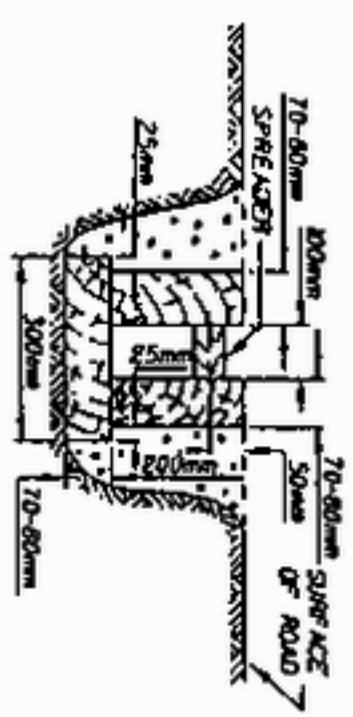
Waterbar: Properly constructed bars should require little or no maintenance. However, all waterbars need to be open at the lower end so water can easily flow away from the roadway. Hand shovel work may be necessary following high runoff periods or severe storms to ensure unrestricted flow.

Road Sloping: Minor regrading may be required to maintain slope angle.

Rolling Dip: Outflows should be kept free of debris to prevent ponding.

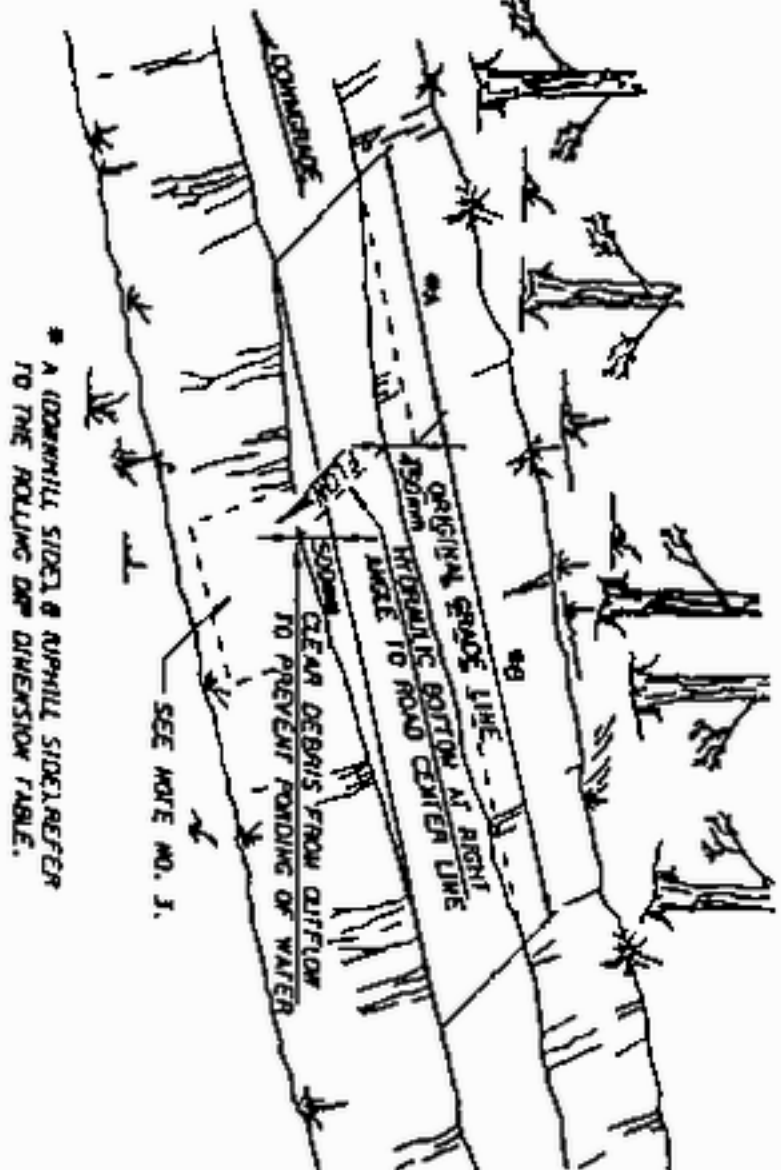


PERSPECTIVE VIEW



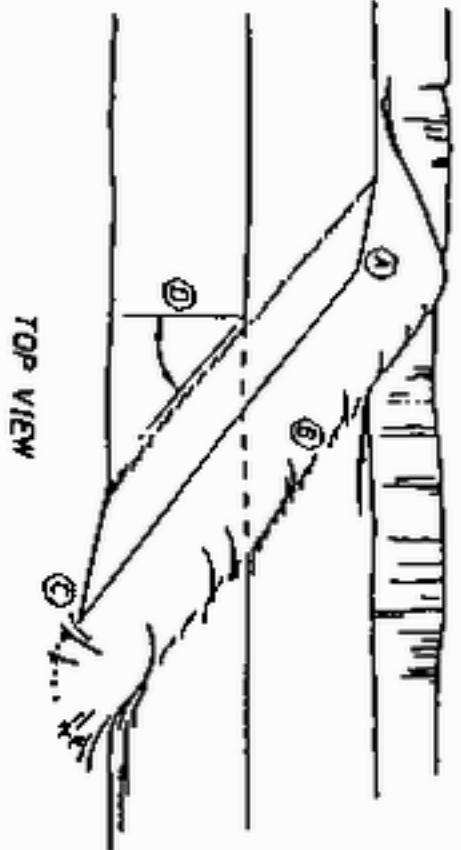
END VIEW

OPEN-TOP BOX CULVERT

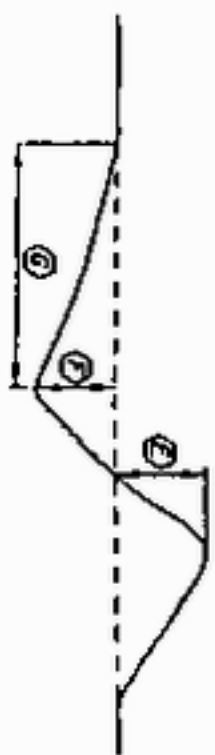


\* A 100mm HILL SIDE & RUPPHILL SIDE REFER TO THE ROLLING DIP DIMENSION TABLE.

ROLLING DIP DETAIL



TOP VIEW



A BANK 1/2-1/4 POINT CUT 150 TO 300 mm INTO ROADBED.  
 B. CROSS DRAIN BERM HEIGHT ABOUT 0.5 m ABOVE ROAD BED.  
 C. DRAIN OUTLET CUT 200 TO 400 mm INTO ROAD.  
 D. ANGLE DRAIN UP TO 45° DOWNGRADE WITH ROAD CENTERLINE.  
 E. HEIGHT UP TO 0.5 m.  
 F. DEPTH TO 0.5 m.  
 G. 1.0 TO 1.2 m.

CROSS SECTION AT CENTER LINE  
 WATERBAR (OR CROSS-DITCH)

(SEE NOTE NO. 2)



A. DRAIN BARRAGE ACROSS ROAD SURFACE FROM TOE OF CUT SLOPE TO FILLSLOPE.  
 B. ROAD SURFACE MUST BE RELATIVELY EVEN TO PREVENT PUDDING & EROSION.

ROAD SLOPING

ROLLING DIP DIMENSION TABLE			
DOWNGRADE	A 100mm HILL	B RUPPHILL	
0% TO 4%	10.5	20	
4% TO 6%	7.5	25	
6% TO 8%	4.5	26	

NOTES

1. ALL OF THE INSTALLATIONS SHOWN ON THIS DRAWING SHALL BE USED IN CONJUNCTION WITH ITD CATALOG OF STORM WATER BEST MANAGEMENT PRACTICES (BMP) FOR HIGHWAY CONSTRUCTION AND MAINTENANCE.
2. CONSTRUCT WATERBARS OR CROSS DITCHES ONLY ON UNPAVED MAJOR ROADS WITH LIMITED OR NO TRAFFIC. THE DEVICE CONFIGURATION SHOULD BE ADJUSTED TO FIELD CONDITIONS.
3. A SEDIMENT FILTERING DEVICE SHALL BE PLACED AT OUTFLOW OF A ROLLING DIP.
4. ALL DIMENSIONS AND DISTANCES ARE IN METERS UNLESS OTHERWISE NOTED AND ALL THE DETAILS SHOWN ARE NOT DRAWN TO ANY SCALE.